2025 Global Data Center Outlook

Shaping tomorrow's digital infrastructure

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Research

Global

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Executive summary

The data center sector will continue to grow at a phenomenal pace in 2025. Based on developments currently under construction and planned, the global data center market is likely to expand at a 15% CAGR through 2027. This is our baseline forecast, with upside potential for a 20% CAGR through 2027.

The industry faces numerous opportunities and challenges amidst rapid expansion. The emergence of new technology provides opportunity for sustainable growth and value creation. The sector also faces significant challenges, including power constraints and increasing demand which is outstripping supply. This report examines the consequential issues facing the global data center sector and provides predictions for the year ahead.

01 Artificial intelligence (AI)

The applications of AI are expanding across nearly all industries. Billions of dollars have been invested in AI over the last couple of years and all signals suggest that AI data center demand will continue to build momentum in 2025.

02 Power grids

Excitement is building for small modular reactors (SMRs), although widespread deployment is not expected before 2030. Look for an acceleration of SMR agreements in 2025, with the total amount of gigawatts committed likely to double.

03 Liquid cooling

Liquid cooling infrastructure has quickly become a default installation in new construction. For existing facilities transitioning to higher-density workloads, liquid cooling will be a viable solution and an opportunity to increase asset value.

04 Capital markets

Roughly $170 billion in data center asset value will need to secure construction lending or permanent financing in 2025. Investment sales volume is likely to record only a modest increase in 2025 due to continued bid-ask spreads.

01

Artificial intelligence

AI demand will continue to build momentum in 2025

The data center industry stands at the dawn of a transformative era, driven by the relentless advancement of artificial intelligence. This technological revolution is not merely evolving the digital infrastructure landscape, it is fundamentally redefining it.

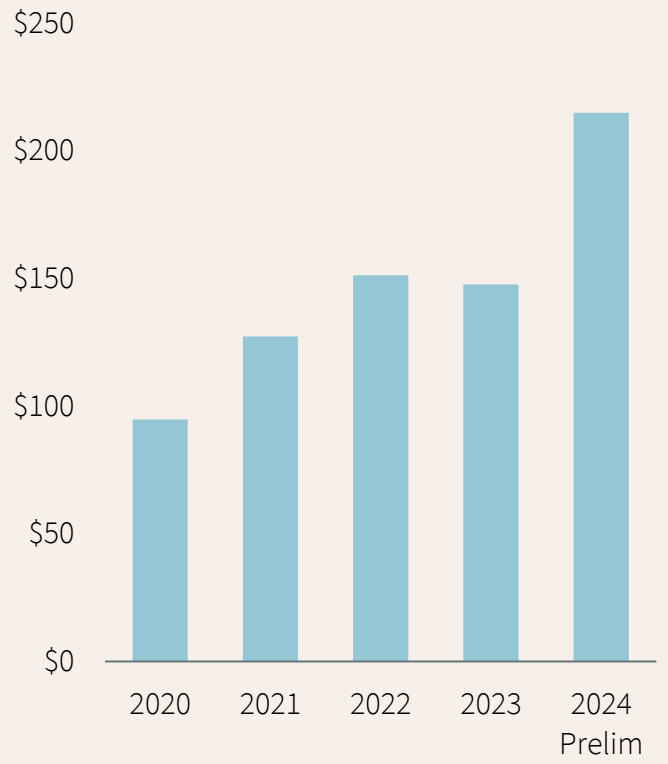
The applications of AI are expanding across nearly all industries including healthcare, financial services, transportation and manufacturing. Billions of dollars have been invested in AI over the last couple of years which is driving demand for more powerful and efficient data center infrastructure. As a result, global data center construction currently stands at record levels. All signals suggest that AI demand will continue to build momentum in 2025.

Rack density will continue to increase, altering facility design

At the core of the AI revolution is the rapid advancement in semiconductor technology. The industry is witnessing a race towards miniaturization that outpaces even Moore's Law.

Over the past two years, graphics processing units (GPUs) have become substantially more powerful, with a transition from 7 nanometer (nm) to 5 nm, and eventually 2 nm technology. For instance, NVIDIA's H100 chip, based on 7 nm technology, boasts around 208 billion transistors with a rack density of 41 kilowatts (kW). The next generation, known as GB200 or Project Blackwell, utilizes 5 nm technology with an expected rack density of 130 kW. Looking further ahead, 2 nm chips are projected to reach an astounding 250 kW per rack. Data center design will continue to evolve as more power can be consumed in smaller facilities.

Big Tech CapEx ($ billions)



Sources: JLL Research, company earnings reports
Note: Includes Alphabet, Amazon, Meta and Microsoft. CapEx predominantly focused on AI. Exact percentages undisclosed.

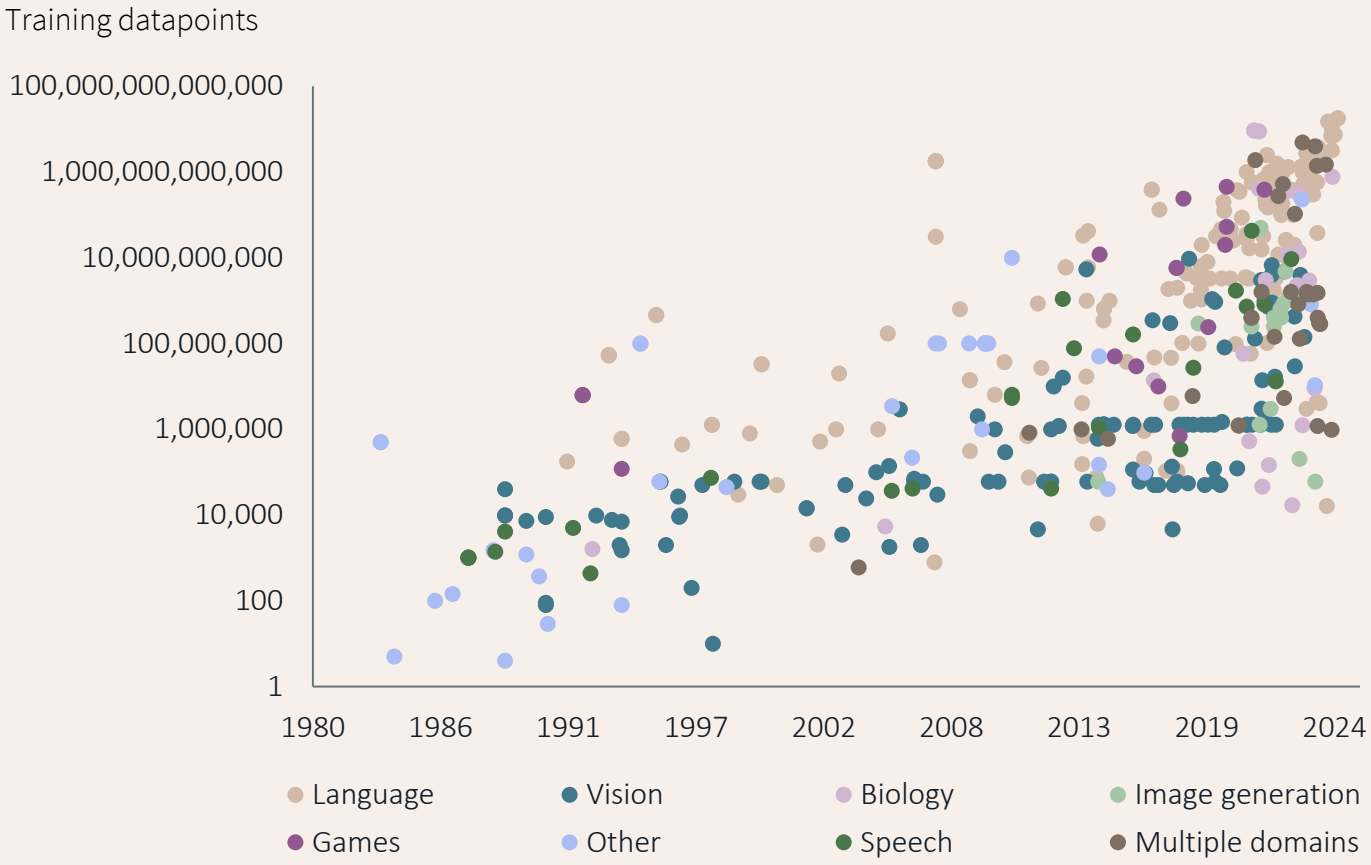
Next generation GPUs will accelerate AI innovation

The rapid advancement of GPU technology has enabled much faster training of large language models. For instance, a computation task that used to take 32 hours to perform can now be completed in just one second with the latest GPU technology.

Given increasing processing speeds, AI programs are able to train on larger and larger data sets. Industry experts are now projecting that in the next couple of years technology companies will run out of high-quality data for training AI language models.

The ability to train, iterate and improve AI models at much faster speeds is making the entire AI ecosystem more valuable. The pace of AI innovation will continue to accelerate with each new generation of GPUs.

AI/machine learning models have exponentially increased in quantity and size



Sources: JLL Research, OurWorldInData, EpochAI

A decoupling of AI training and inference facilities

The power demands for AI training facilities are enormous, with new projects regularly requesting 1 gigawatt (GW) of power or more. For context, a 1 GW facility consumes the same amount of power as 800,000 homes in the U.S over the course of a year.

This has led to a distinction between AI training facilities, which are often built near power sources, and inference facilities, which are located closer to population centers for end-user access and lower latency. This separation is necessary due to the massive computational requirements for training versus the more distributed nature of inference operations. The decoupling of AI data centers has similarities to the industrial sector and the distinction between regional warehouses and last-mile facilities.

02

Power grids

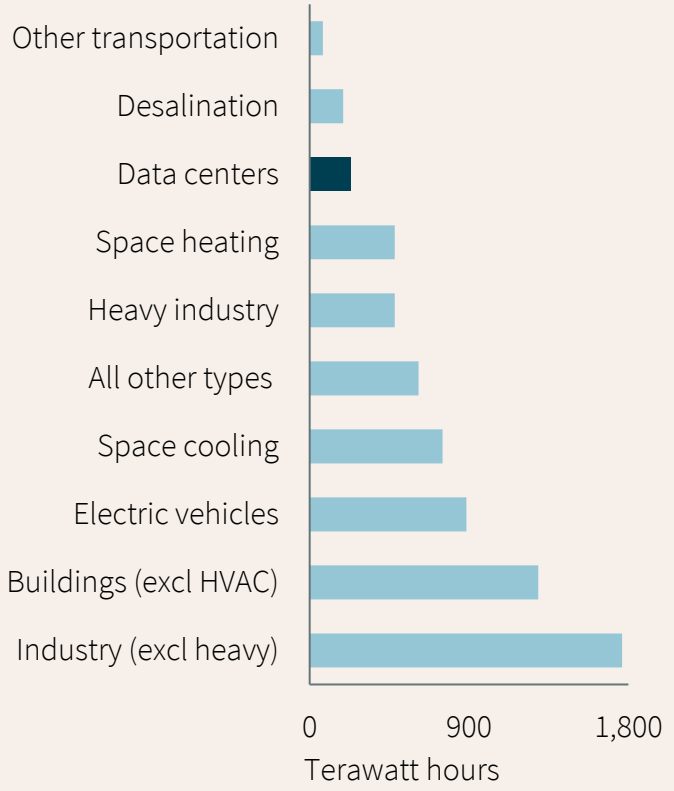
Data centers will represent a relatively small component of global electricity demand growth in 2025

According to the International Energy Agency (IEA), global electricity demand will grow by around 4% in 2025. This is the highest annual growth rate in the past two decades, excluding the rebounds seen after the global financial crisis and the COVID-19 pandemic. Demand growth will be driven by factors including strong economic activity, increased use of air conditioning amid rising temperatures, and increasing adoption of technologies like electric vehicles (EVs) and heat pumps.

The immense media coverage of data centers over the last couple of years has led many to improperly associate the global power challenges primarily with data centers. While it is true that data centers consume large quantities of power and that the sector has been growing rapidly in recent years, it is also important to note that data centers will only represent about 2% of global electricity consumption in 2025. Furthermore, the increase in data center electricity demand through 2030 is projected to be less than a third of the increased electricity needed for both EVs and air conditioning.

Data centers are one component of a complex global power dilemma. Increasing adoption of EVs, the electrification of machinery, rising power consumption in developing countries and a myriad of other factors are all contributing to increased global power consumption. A holistic approach will be required to solve the global power challenges, including cleaner energy generation and more efficient energy consumption across all industries and property types.

Global electricity demand growth 2023-30



Sources: JLL Research, IEA

Clustering phenomenon is resulting in power delivery bottlenecks, delaying developments in major markets and shifting investment to new areas

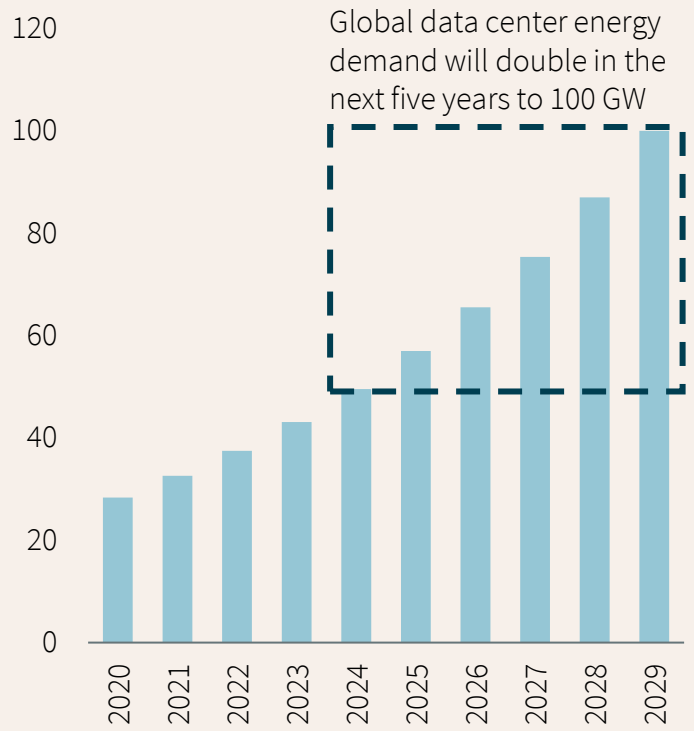
Data centers tend to cluster together. In some metropolitan areas this is leading to significant bottlenecks in power delivery to new developments. The largest global data center markets of Northern Virginia, Tokyo and London are good examples of this.

Additionally, data center clusters are distributed unevenly across the globe. As a result, there are some notable states and countries where data centers account for a considerable proportion of total electricity demand. For instance, data centers in Singapore account for around 7% of total electricity consumption. In Ireland, they account for 21% of total electricity consumption. And in the United States, they represent about 26% of Virginia's total power consumption.

Data center energy consumption forecasts through the end of the decade are clouded by a host of uncertainties, including the pace of AI adoption, the expanding array of AI applications and the potential for significant energy efficiency gains. But what is certain is that the data center sector will continue to grow at a rapid pace, driven by the ever-increasing need for computing power. Forecasts estimate that global data center energy demand will double in the next five years to 100 GW.

Given the extraordinary levels of demand, both established and emerging markets will experience greater levels of development in 2025. Hyperscalers will likely be first-movers into new markets, followed by colocation providers. Data center development will continue to cluster where there is a confluence of power, land, infrastructure and talent.

Global data center energy demand (GW)



Sources: JLL Research, Structure Research
Note: Capacity includes hyperscale and colocation.

Power transmission challenges will intensify, delaying data center developments up to four years or more

Power infrastructure bottlenecks are a major impediment to data center development. Power scarcity garners most of the headlines, but equally as significant are the extended timelines required to build transmission lines. These challenges will continue to intensify as the data center sector expands rapidly into new geographies.

In many markets it can take four years or more to have high-capacity power lines extended to new development sites. Most of this delay is associated with securing easements and regulatory approvals. Supply chains continue to be challenged, particularly for transformers and switchgear, but equipment procurement is not the primary reason for transmission delays.

These challenges have led to a shift in site selection criteria, with land now being evaluated based on available power capacity and proximity to transmission lines, rather than pricing or total acreage.

Utilities are now more selective in Purchase Power Agreement (PPA) approvals, using thorough intake forms and application fees to filter out speculators. This is generally seen as positive for the industry as it focuses limited resources on serious, well-funded projects. However, it does not address the fundamental issue of long lead times for infrastructure development.

Enthusiasm for nuclear will continue to gain momentum

Nuclear power is emerging as a preferred solution to meet the growing energy demands of data centers, particularly for AI and high-performance computing applications. Tech companies are the largest occupiers of data center space, and they have among the most aggressive net zero targets. Nuclear provides a solution to both challenges.

As traditional power grids struggle to keep up with increasing power demands, nuclear energy is gaining enthusiasm as a clean and reliable alternative energy source for data centers. Multiple nuclear PPAs were signed in 2024 involving active nuclear plants as well as decommissioned plants which will be reactivated around 2028. However, the development pipeline for additional large-scale nuclear facilities is limited. Instead, attention has turned to another form of nuclear energy: small modular reactors.

Small modular reactor (SMR) agreements will likely double in 2025, unlocking a new source of green energy for data centers

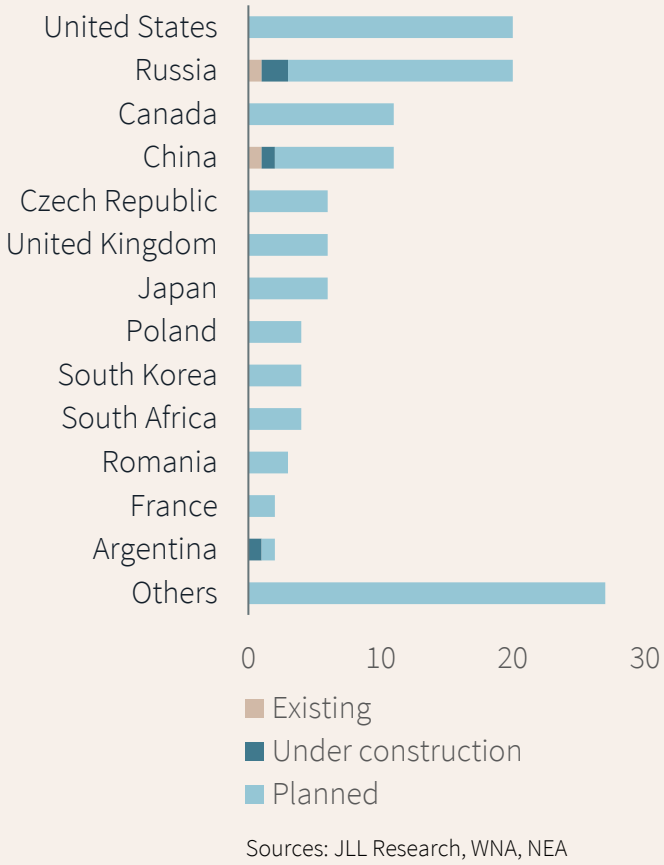
In addition to traditional large-scale nuclear, the data center industry is exploring SMRs that can provide 1.5 to 300 megawatts of power. SMRs are modular and scalable, making them potentially an ideal solution for data centers at a fraction of the traditional large-scale nuclear cost.

It is important to note that SMR technology is still in the early stages of development, with commercial deployment in the U.S. not expected until 2030 at the earliest. However, if SMRs materialize as a credible power alternative, they could provide data centers with abundant green energy. This would have significant implications for site selection, data center design and ongoing operations.

There are numerous companies worldwide developing SMRs given the level of excitement and investment in the sector. According to the Nuclear Energy Agency (NEA) and the World Nuclear Association (WNA), more than 100 sites are being evaluated for SMR installations. Several notable agreements were reached in 2024 between SMR companies and data center operators. In 2025, look for an acceleration of SMR announcements, with the total amount of gigawatts committed likely to double.

Several SMR developers have emerged as early winners after securing high-profile contracts including Oklo, Kairos, X-energy and Holtec. However, the field of competitors is likely to evolve in the coming years as the technology is developed, tested and implemented.

Commercial SMR facilities by country



Sources: JLL Research, WNA, NEA

Despite optimism, challenges lie ahead for SMR deployments and the data center sector

Despite the opportunity that SMRs present, challenges remain. Regulatory hurdles, high initial costs and public perception issues still pose significant barriers to the widespread adoption of SMRs. The nuclear and data center industries will need to work closely with governments, regulatory bodies, local communities and investors to overcome these obstacles.

The initial deployment of SMRs in the early 2030s will likely take place at existing nuclear facilities where the necessary infrastructure, regulatory approvals and nuclear professionals are already in place. The following phases of SMR deployment will likely be at decommissioned power generation plants due to their existing infrastructure, or in undeveloped rural areas, removed from major populations centers. This will allow more time for the technology to mature and for the public to become comfortable with SMRs. Critically, SMR installations embedded within large metropolitan areas are not expected for some time.

Oklo Aurora powerhouse (Image: Gensler)

03

Liquid cooling

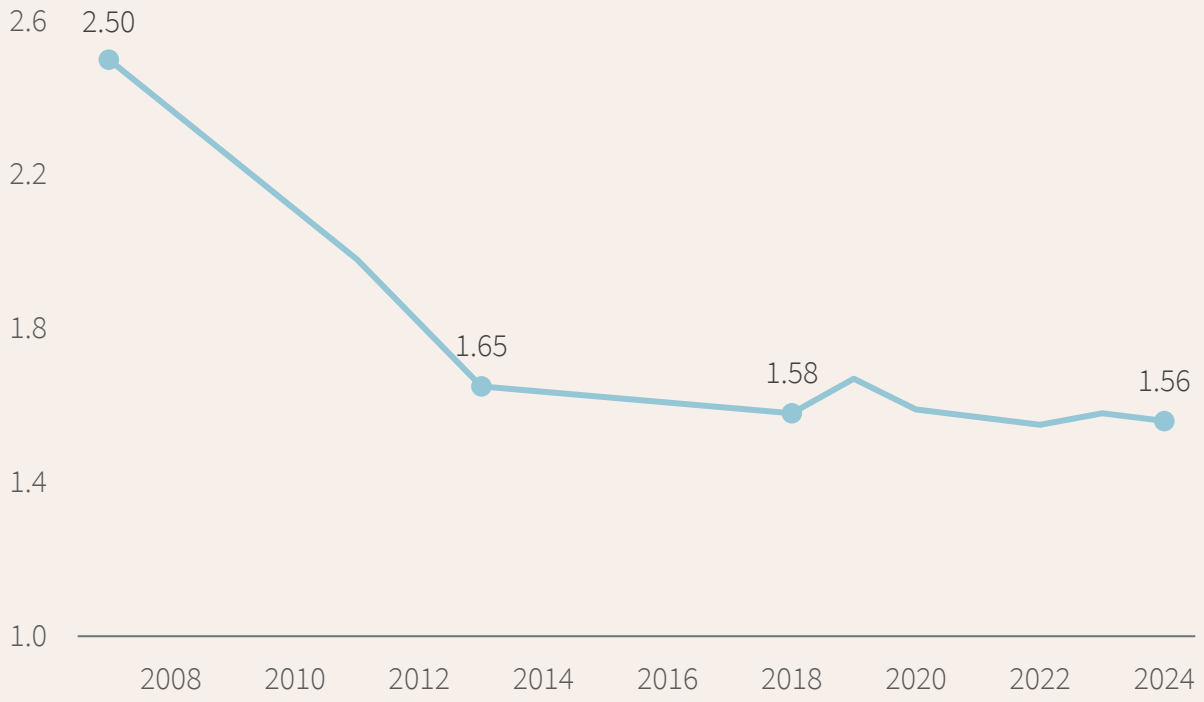
Balancing computing power and sustainability will be a significant challenge in 2025

The race for AI supremacy is no longer just about computational power — it is becoming a battle for energy efficiency. As tech giants pour billions of dollars into AI infrastructure, they are also grappling with the challenge of cooling increasingly dense and power-hungry GPU clusters. This has sparked a new wave of innovation, from the development of more energy-efficient chip architectures to advanced liquid cooling systems.

AI power demands raise critical questions about sustainability and resource allocation. As AI continues to grow, will our power grids be able to keep pace? And what level of environmental cost is the public willing to bear for the progress of AI?

The AI revolution is undoubtedly changing the world, but AI's energy footprint may be its most profound and lasting impact. New PUE (power usage effectiveness) regulations and greater rack densities will drive the industry towards liquid cooling, as it is nearly impossible to achieve low PUE values with traditional air cooling alone.

Power usage effectiveness (PUE) worldwide



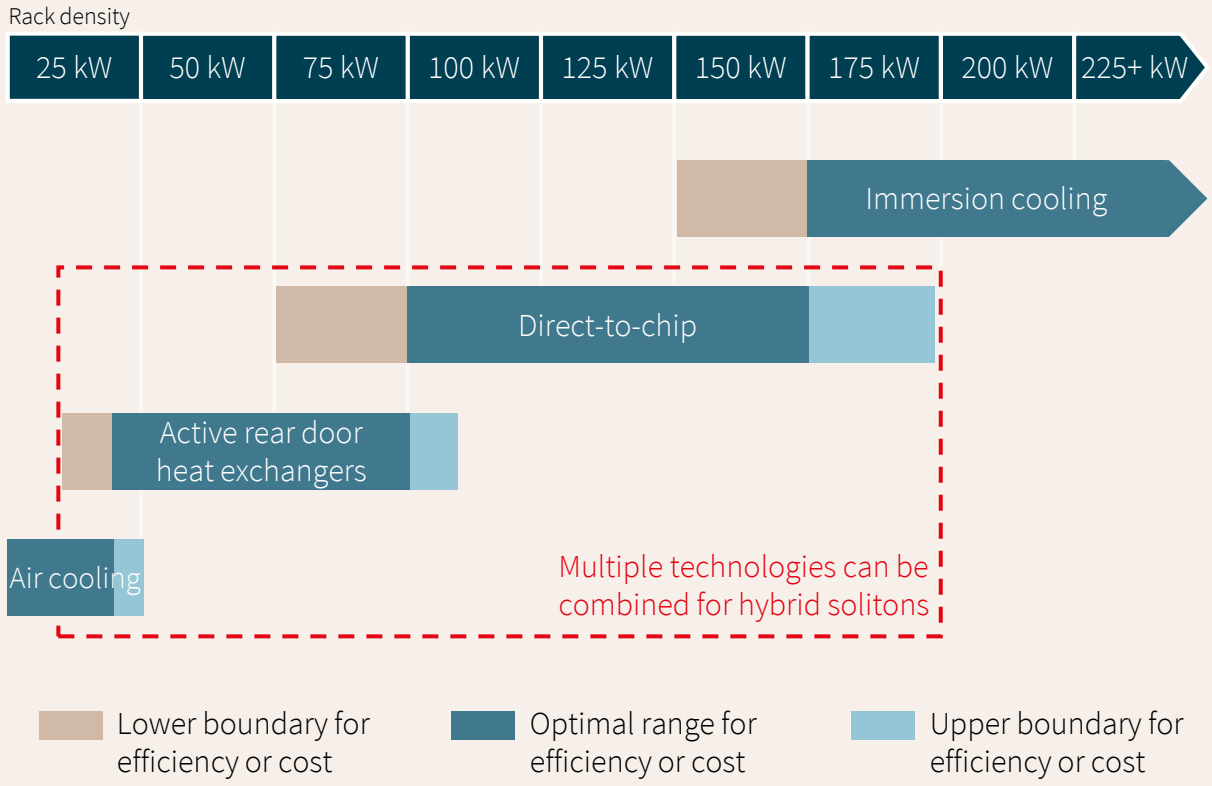
Sources: JLL Research, Uptime Institute
Note: PUE is the ratio of total facility energy to IT equipment energy used in a data center. 1 = perfectly efficient.

GPU advancements require a shift to liquid cooling, altering data center design

The surge in power density necessitates a shift in thermal management strategies. NVIDIA's latest AI chips consume up to 300% more power than their predecessors, and industry forecasts suggest that global data center energy demand will double in the next five years. This exponential growth in energy demand is reshaping the landscape of data center design.

Liquid cooling is becoming essential for high-density racks. A hybrid approach is typically employed today, with 70% liquid cooling and 30% air cooling. Liquid cooling installations are currently taking the form of rear door heat exchangers (RDHx) and direct-to-chip (DTC) technologies. Within new construction, liquid cooling infrastructure has quickly become a default installation. Additionally, RDHx and DTC retrofits are considered a viable solution for existing facilities transitioning to higher-density workloads.

Applicable cooling technologies by rack density



Source: JLL Research
Note: Ranges are approximations. Specifications vary by manufacturer.

Immersion cooling is coming, which will require a shift in structural design

Immersion cooling will likely become a common thermal management strategy as GPUs push above 150 kW per rack. But broad implementation of the technology is still a few years away. The global average rack density is currently only 12 kW and immersion cooling is implemented in less than 10% of data centers today. Deployments of immersion cooling over the next few years will be concentrated in AI facilities and in sections of traditional data centers running AI workloads.

While the technology promises many benefits, including highly efficient cooling, it also faces challenges related to liquid quality, reliability and maintenance. Additionally, immersion cooling introduces new challenges in structural design due to weight considerations. The weight of the largest cooling baths can reach up to four metric tons when filled with equipment and cooling fluid, which requires significantly reinforced flooring. This will need to be addressed in data centers implementing immersion cooling on a large scale.

What will likely be more common over the next few years are operators implementing test deployments, using smaller immersion tubs which weigh significantly less and can be deployed in existing facilities without major renovations. This will allow time for operators to become comfortable with the technology before rolling out larger deployments.

Credit DUG Technology

04

Capital markets

Investor conviction in data centers will remain steadfast

Investor appetite for data centers will remain strong through 2025. Data centers are generally viewed as long-term safe havens and the sector has been benefitting in recent years from a diversification of investment portfolios towards alternatives.

Data center investor conviction is driven by a compelling global narrative of exponential demand for computing power and data storage, constrained supply due to power scarcity, attractive financial returns, and growing excitement around the potential of artificial intelligence.

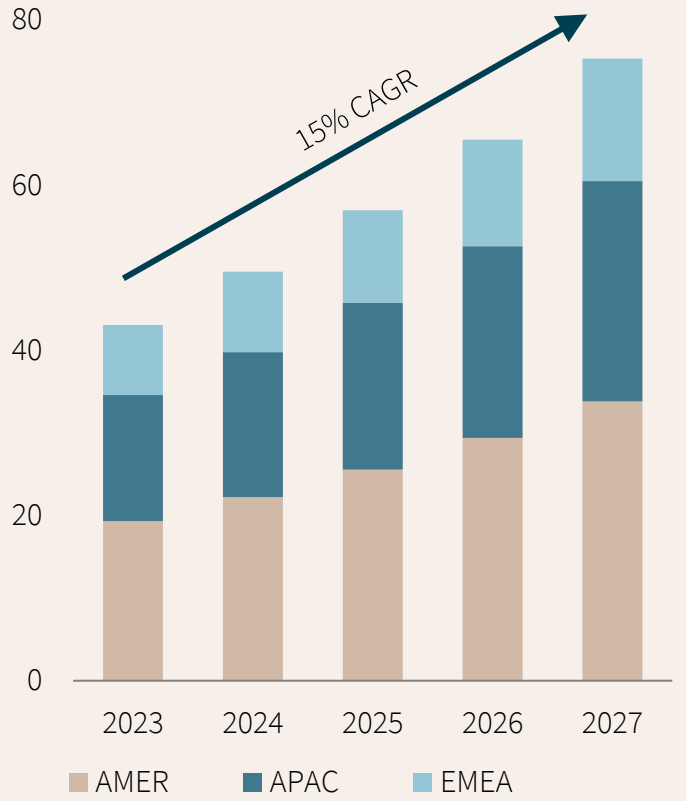
The largest investors have been institutional, private equity and alternative investment. Institutional has been purchasing global operators while private equity has focused on funding development. Alternative investment have been purchasing individual assets when available.

2025 will be another record year for development financing

Data center development financing will achieve another record year in 2025. Across the hyperscale and colocation segments, an estimated 10 GW is projected to break ground globally in 2025. Separately, 7 GW will likely reach completion. This equates to roughly $170 billion in asset value that will need to secure either development or permanent financing in 2025.

Data center development financing is typically arranged at 65% to 80% loan-to-cost while permanent financing is typically arranged at 65% to 75% loan-to-value. The majority of data center development financing has historically been originated by a handful of lenders, but as the deals get larger, the lending pool is slowly increasing and club deals are becoming more common.

Global data center capacity (GW)



Sources: JLL Research, Structure Research
Note: Capacity includes hyperscale and colocation.

Private equity will play a significant role in development financing

Data centers remain a niche sector with a limited number of asset trades occurring each year. As a result, investors are restricted in their ability to gain exposure to the asset class through traditional property acquisition. Additionally, the highly technical and capital-intensive nature of data centers creates significant barriers to entry for new participants.

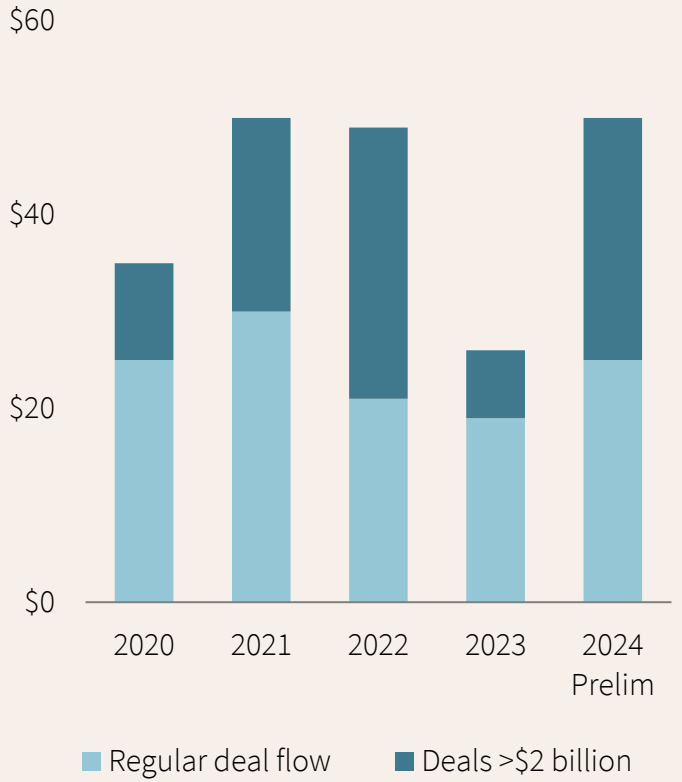
Investors have been primarily gaining exposure to the sector through development financing. This is particularly true for private equity firms, which have been the main source of equity in development deals in recent years. Equity placements in land development and ground-up construction will remain the primary way that investors gain exposure to data centers in 2025.

Global M&A to slow, joint ventures to increase

The data center sector experienced a deluge of M&A activity over the last five years totaling more than $200 billion. M&A provided businesses an opportunity to quickly scale during a period of rapid growth for the sector. But the industry is reaching an inflection point as it matures, and the flow of megamergers will likely slow.

The basis for this outlook is that the largest developers and operators have established global platforms over the last several years. In 2025 they will look to grow organically and through bolt-on acquisitions instead of paying a premium for growth via large-scale acquisitions. While M&A investment volume will likely decline, look for an increase in joint ventures, particularly in developing countries as the largest industry firms partner with regional groups for help navigating the local political, regulatory and business landscapes.

Global data center M&A activity ($ billions)



Sources: JLL Research, Synergy Research
Note: Preliminary 2024 figures inclusive of $16B AirTrunk deal.

Asset trades likely to increase only moderately in 2025

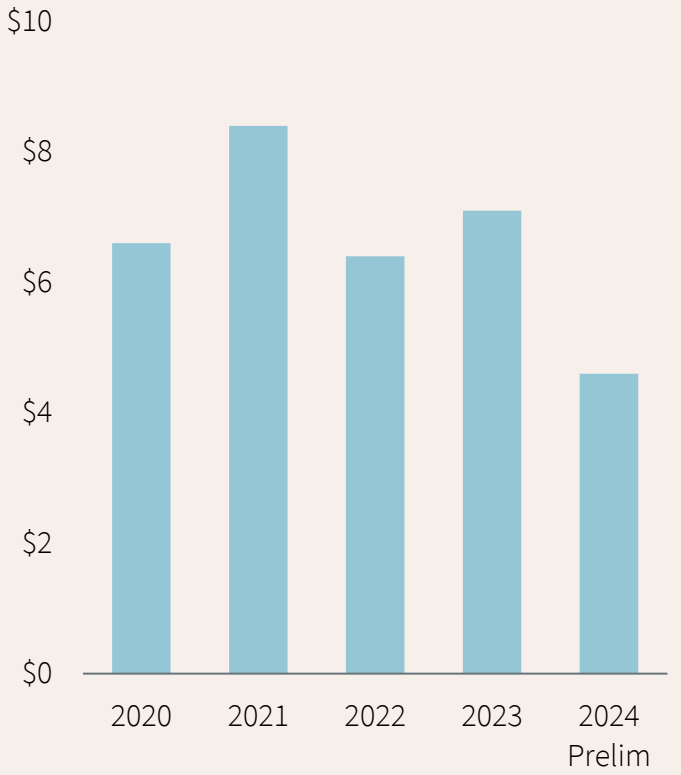
A relatively limited number of data centers trade each year. For context, global data center investment sales (excluding entity trades and recaps) have averaged just $7 billion annually since 2020. This compares to an annual average of $241 billion for office assets over the same period.

An increased number of developers will be looking to exit positions and recycle capital in the year ahead. But in many cases, these developers will have challenges making the numbers work. As result, global data center trading volume is likely to record only a modest increase in 2025.

The modest increase, despite significant investor interest, is due to several factors. First, the significant upward move in interest rates in most G10 countries between the time assets were financed a few years ago and today has created a significant bid-ask spread.

Second, there are variances in relet assumptions between buyers and sellers which are contributing to bid-ask spreads. Most owners are not in a position where they need to sell, so they are likely to hold on to assets over the next year and wait for financial conditions to become more advantageous.

Global data center sales volume ($ billions)



Sources: JLL Research, Real Capital Analytics
Note: As of November 2024. Excludes entity trades and recaps.

Debunking data center obsolescence; data centers will appreciate in value over time with proper investment

Questions about data center obsolescence are common, particularly from investors who are new to the sector. To start the conversation, there needs to be a general understanding that the data center sector is experiencing immense demand growth. For this reason, there is extensive demand for data center space both old and new, and it is imperative that all existing capacity is retained while additional facilities are constructed to meet new demand.

Most of the data center media headlines focus on the implications of AI, but AI represents only one component of data center demand. Traditional, lower-intensity workloads such as data storage and cloud-based applications still make up the majority of demand. Even optimistic adoption scenarios suggest that AI workloads may only grow to 50% of data center capacity in 2030.

In 10 years from now, not every data center will be a specialized AI facility. In fact, only portion of data centers will be dedicated solely to AI applications. The majority of data centers will run a combination of traditional workloads and AI applications. Therefore, older data centers are not in danger of becoming obsolete. Instead, they will remain a valuable component of the global data center ecosystem.

The notion of data center obsolescence typically focuses on the pace of technological change. The thinking is that a data center's value quickly declines due to advances in technology. But one must keep in mind that the technology housed within a data center is constantly being upgraded. It is just as common to see the latest generation NVIDIA GPUs in a newly-constructed data center as it is in a colocation facility that was built 15 years ago.

Aside from the contractual lease agreements, the majority of a data center's asset value lies within the existing power supply and the building's infrastructure (electrical, plumbing, HVAC, generators, etc.). The in-place power supply is especially valuable given the current challenges securing power for new developments.

For these reasons, data centers will not become obsolete within 10 years of being constructed, a timeframe which is typically referenced in conversations about obsolescence. Instead, with proper maintenance and investment, data centers will appreciate in value over time.

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